and Haime on that account as a special division of the corals, the *Zoantharia tabulata.*

By the researches of the late Prof. Agassiz, Prof. Verrill, Mr. Moseley, and others, these peculiar structures, the tabulæ, on which MM. Milne Edwards and Haime relied as the foundation of a natural group, have been proved to be of very secondary importance, and to exist in corals of most widely different structure in other and more essential particulars.

Prof. Nicholson, in his preliminary review of the various different forms thus formerly brought together, describes the most important structural details of each, and assigns them to their several places in the animal series. Some, as Heteropora, are, according to the late researches of Mr. Busk, of Bryozoan affinity, and Mr. Busk's results have been so very recently obtained that this fact can only be explained in the book in a note appended to the preface. The Milleporidæ and their allies are Hydroids, the Helioporidæ and Heliolites Alcyonarians, the Pocilloporidæ Madreporarians. The Favositidæ and Syringoporidæ, notwithstanding the close relationship of the latter, in general appearance to the Tubiporine Alcyonarians, the author refers, contrary to the opinion of Dana, Haeckel, and Zittel, to the Madreporaria, expecting "that they will find a place, though a special one, in the series of the *Zoantharia perforata.*"

Twelve groups of tabulate corals in all are reviewed, namely, the Milleporidæ, Pocilloporidæ, Favositidæ, Colummariadæ, Syringoporidæ, Auloporidæ, Halysitidæ, Tetradiidæ, Thecidæ, Helioporidæ, Chaetetidæ, and Labechidæ. It is to be hoped that so heterogeneous an assemblage will not be placed again side by side in scientific works, now that the wide differences by which its components are naturally separated are fully known. Succeeding the general introduction there follow in the book a series of chapters devoted to the description of the peculiarities of the families and genera of those of the above cited families of corals which are of Palæozoic age, with detailed descriptions of certain selected types and discussions on the affinities of each family, the affinities being in many cases as yet obscure.

The text is illustrated by excellent woodcuts, and there are fifteen plates containing details of the structures of various forms as exhibited in microscopic sections. The whole cannot but prove of value to specialists who occupy themselves with the investigation of these difficult fossil organisms; but the matter of the book is necessarily too technical in character to allow of detailed review with advantage to the readers of NATURE. Some of the descriptions of types and figures have appeared already in the *Annals and Magazine of Natural History.*

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

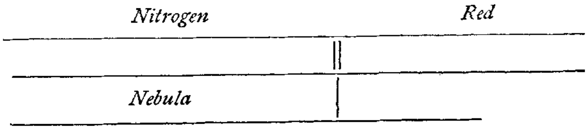
Dissociation of the Metalloid Elements

IN the account given in NATURE, vol. xxi. p. 445, of M. Raoul Pictet's proposal to dissociate the metalloid elements the following reason is given as the ground of his belief that these elements are compounds:—

"The spectrum of the sun when scrutinised with the most elaborate skill and knowledge reveals another very striking circumstance. A large number of the substances regarded by the chemist as elements have now been recognised by the characteristic absorption lines of their spectra as existing in the heated matters surrounding the sun. The researches of Mr. Lockyer show that nearly forty of the metals are thus to be detected. But not a single metalloid is thus discoverable. Indeed so marked is their absence that the presence of hydrogen in such great abundance is held by no less an authority than Mr. Dumas to be a convincing proof that hydrogen is a metal and not a metalloid."

M. Pictet is doubtless unaware that for many years I have advocated the same conclusion. The grounds I have given for this belief are twofold, firstly, that the peculiar chemical reactions of these elements on which the law of even numbers rests leads to this result; and, secondly, that no spectrum of any one of these elements has as yet been found in the light of the sun or fixed stars. Oxygen, I may say, is not included in my list. My first published observations on this subject date from the years 1866–1867 ("Calculus of Chemical Operations," part 1, *Trans.* R. S., 1866, p. 859, and *Chemical News,* June 14, 1867, p. 302). Last year I had occasion to recur to this question, and in an article by myself in the *Philosophical Magazine,* June, 1879, p. 430, the following passage occurs:—

"It is a significant fact that a very large proportion of the class of elements which I have termed composite elements have not been found in the sun. In reply to inquiries on my part Mr. W. Huggins writes to me thus:—So far as I know, nitrogen, phosphorus, arsenic, antimony, boron chlorine, iodine, bromine, have not been found in the sun. In one paper Lockyer suspects iodine. Dr. Miller and I found coincidence of the three lines of antimony with three lines in Aldebaran. Though this observation would show considerable probability of antimony in star, I do not think the spectroscope (two dense prisms of flint glass) was sufficiently powerful to make its existence there certain. In the case of nitrogen, no coincidence was observed in any of the stars. In my paper in the *Transactions* of the Royal Society on Spectra of Nebulæ, I show coincidence of principal line with the strong line in spectrum of nitrogen. Now this line of nitrogen is a double one; and I was not at first able to be certain if the line in the nebula was similarly double. Subsequently with the powerful spectroscope I used for the motions of stars, I was able to make a certain determination of this point (*Proceedings,* R. S., 1872, p. 385). I found the line in the nebula single and coincident with the middle of the less refrangible of the components of the double line.



I say 'middle' because the line in the nebula is narrower and more defined than either of the two lines forming the double line. I made experiments to see if under any conditions of pressure and temperature the more refrangible of the two lines fades out, so as to leave only the one with which the line in the nebula is coincident. I did not succeed. So the matter stands. Is nitrogen compound? Are there any conditions under which the one line only appears? Has the line in the nebula no real connection with nitrogen further than being sensibly of the same refrangibility?

"Now we must either consider that the matter of these elements so abundant on the earth does not exist in the sun or stars (which is hardly probable), or that they have passed into forms of com-

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bination in which they cannot be recognised by the spectroscope (which is also hardly admissible at that elevated temperature), or that they have been decomposed."

The important work of Victor Meyer on the behaviour of chlorine and iodine at elevated temperatures which must now be regarded as finally established by the experiments of which an account is given in the recent number of the *Berichte der deutschen chemischen Gesellschaft* (March, 1880), and on which I ventured to offer some theoretical considerations in a paper which appeared in the *J. Chem. Soc.* last autumn, point in the same direction. It is difficult not to admit the force of such a body of coincident evidence as that of which I have here given a brief outline.

March 14 B. C. BRODIE

The Aurora at Last

YESTERDAY, Wednesday, March 17, was a magnificently bright sunshiny day from early morning to latest evening; and at 9 p.m. the aurora appeared, just as it used to do years ago in the last sun-spot cycle, and when that strange influence was in its then vigorous existence. Your readers were warned last October that the sun-spots of the new cycle had then begun "in earnest," and now we have to chronicle the first of their *auroral* fruits.

It was a long low arc of mild quiescent light, about 2° in transverse breadth, 20° long, rising about 7° high in the middle, and sensibly dark between its lower edge and the horizon; the centre was over the north-north-west point of the horizon, but swayed slowly several degrees of azimuth on either side. Towards 11 p.m. the arc began to break up into brighter pellets of light, and these shot fainter rays upwards, making a brilliant and variegated appearance for a few minutes, but apparently soon exhausting itself, for after that there remained only a faint ghostly image of the arc up to 1 a.m.; all this being clearly visible to the naked eye, although a moon seven days old and in 24° N. Decl. was shining brightly in the west.

In the spectroscope, with a narrow slit, nothing but the one inscrutable citron-coloured line appeared, its place in wave-numbers, per British inch, and as ascertained in both hydrogen and carbonic oxide vacuum tubes, being between 45592 and 45690. PIAZZI SMYTH

15, Royal Terrace, Edinburgh, March 18

A Museum Conference

ALLOW me to deprecate most strongly any attempt to form an association having for its object to talk about museums. Museum officials either know their business or they do not. In the former case they have something better to do than to talk; in the second case the less they say the better. The multiplication of conferences threatens to become a nuisance, and special conferences for every grade, class, and description of humanity will soon be proposed by fussy idlers. We shall be told that it is time to have a conference of housekeepers, of lamplighters, of railway guards, boot-makers, beadles, perhaps ballet-girls.

The fact is that endless time and trouble and money are wasted in England in maintaining rubbishing local museums in the care of ignorant and pretentious curators. Conferences are not required, but *proper salaries* for the curators, who should be educated and capable men; were such men secured by adequate salaries they would soon make the museums in their charge very different from what they now are.

A curator with proper salary ought to be made to attend daily at his museum during office hours, and not allowed to leave it to take care of itself whilst he is lecturing here or there, or eking out his pay by literature. ACADEMICUS

I AM glad to see that Mr. Paton has, in NATURE, vol. xxi. p. 442, again revived the subject of a museum conference, and offers to give his aid towards such attaining a practical form. The desirability of a Museum Association was first suggested in an article in NATURE, vol. xv. p. 276, and this was followed by a more definite proposal for a conference by "J. P.," and with the addition of a letter in favour of the same object by Dr. Meyer nothing further was published about it. This looked as if the subject was not considered of any great importance, but I believe many curators were decidedly in favour of it, and only awaited it assuming a practical form to give it their hearty support. The success which has attended the Library Association gives every reason to believe that the formation of a similar association of museum officials would lead to equally good results. Apart from the benefits to be derived from an interchange of ideas and results of experience, which, considering the varied nature of museums and the many practical questions involved in their successful management, could not fail to be considerable, there are many things affecting provincial museums generally that would be greatly advanced by united action. One of these, the distribution of the British Museum duplicates, I should like to refer to. In the British Museum Removals Bill a clause was inserted at the instigation of Mr. Mundella, M.P., and Mr. Chamberlain, M.P., which states that "the Trustees of the British Museum may also give away any duplicate works, objects, or specimens not required for the purposes of the Museum." Instead of giving away, however, I learn that the Trustees are about to *sell by auction* some of the duplicate prints, drawings, &c., in the Museum; and fearing that other duplicates might be disposed of in a similar manner I had the matter brought before Mr. Mundella, who obtained an interview with the Right Hon. Spencer Walpole, Chairman of the Trustees, and was informed that instructions had been given for duplicates in the Natural History Departments to be laid aside and catalogued for distribution among the principal museums. This is somewhat reassuring, but why not treat all their duplicates in this way?—for it should be remembered that provincial towns contribute their share of imperial taxes.

I must not, however, occupy your valuable space with matters that ought properly to be discussed by such a conference as Mr. Paton suggests; and I hope that all who are interested in museums will heartily co-operate with Mr. Paton, whose great success in developing the museum at Glasgow and his extensive acquaintance with museums both in Britain and on the Continent, eminently qualify him to speak with authority on the subject.

Sheffield Public Museum, March 23 E. HOWARTH

A Method of Calculating the Expansion of a Substance on Vaporisation

HAVING occasion last summer to determine the volume of gas which would result from the vaporisation of a given quantity of a certain solid, I made use of a simple way of obtaining approximate results which may not prove uninteresting to some of your readers, unless, as is very likely, they have already made use of it or a better way themselves. For purposes of illustration we may take it that 1 gram of hydrogen gas occupies a volume of 11,200 c.c. at normal pressure and temperature; moreover, the weight of 1 c.c. of water is 1 gm. at 0° C.

Knowing the atomic weight and specific gravity of any liquid or solid, we can now find the volume which 1 c.c. of it will assume on passing into the gaseous state by a simple "rule of three" sum.

For the weight of 1 c.c. of the substance is given by the number which indicates its specific gravity; and the weight of 11,200 c.c. of its gas is given by its atomic weight.

Hence

$$\frac{\text{sp. gr.}}{\text{at. wt.}} \times 11{,}200 = \text{vol.},$$

to which 1 c.c. of the substance expands on becoming gaseous.

It is interesting to note that the fraction $\frac{\text{sp. gr.}}{\text{at. wt.}}$ is the reciprocal of $\frac{\text{at. wt.}}{\text{sp. gr.}}$, which is the expression for the so-called atomic volume (v) of a substance, and thus the expansion of 1 c.c. of a solid or liquid as it becomes gaseous may also be determined by dividing the number 11,200 by the atomic volume of the substance.

In this way we find that 1 c.c. of sodium will occupy 474 c.c. in the state of gas, and 1 c.c. of potassium 249 c.c., or, what is the same thing, 1 c.c. of each of these substances in the gaseous state will occupy $\frac{1}{474}$ c.c. and $\frac{1}{249}$ c.c. in the solid state respectively. But equal volumes of gas under the same conditions of temperature and pressure contain an equal number of molecules, and hence $\frac{1}{474}$ c.c. and $\frac{1}{249}$ c.c., the products of the condensation of equal volumes of potassium and sodium gas must contain an equal number of molecules. From this we readily deduce a real physical meaning for the fraction $\frac{\text{at. wt.}}{\text{sp. gr.}}$, or, in other words, for the expression "atomic volume," the significance of which, at first, was merely conjectured.

Lists of homologous series of elements and compounds, with their "condensation numbers" attached, give very interesting results; I have only one such at hand, which I here give:—

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